AUTOMATIC SHEET FEEDER

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to an automatic sheet feeder, and more particularly to an automatic sheet feeder applied to a duplex image input/output apparatus.

Description of the Related Art

A conventional duplex scanner usually has an automatic sheet feeder to turn over a document three times and feed the document through a scan region three times. When the document passes through the scan region at the first time, its front side is scanned. When the document passes through the scan region at the second time, its back side is scanned. When the document passes through the scan region in the third time, the scanner performs no scan operation because the third sheet-feeding operation is performed such that the document is arranged to return to its original order.

Consequently, in each scan procedure for one document, it is necessary to wait for the document to thirdly pass through the scan region and then to feed a next document for scan. The conventional automatic sheet feeder wastes a lot of unnecessary waiting time such that the scan operations cannot be performed rapidly.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide an automatic sheet feeder capable of accelerating the duplex image processing procedures and meeting the

simplex image processing procedures.

In order to achieve the above-mentioned object, the invention provides an automatic sheet feeder including a sheet input tray, a first passageway, a second passageway, a third passageway, a sheet-feeding mechanism and a sheet output tray. The sheet input tray is used to store a plurality of sheets including a first sheet and a second sheet, and each of the sheets has a front side and a back side. The sheets may pass through the first to third passageways one by one.

The first passageway communicates with the sheet input tray, a first end of the second passageway selectively communicates with the first passageway, a second end of the second passageway communicates with the first passageway, and the third passageway selectively communicates with the first passageway. The sheet-feeding mechanism feeds the first sheet successively from the sheet input tray to the first passageway, the second passageway, the first passageway, and the third passageway. The sheet output tray, in which the sheets are stored, communicates with the third passageway. The front side of the first sheet is toward opposite directions when it passes through the first passageway at the first and second times. When the first sheet is fed to the third passageway, the second sheet is fed to the first passageway.

According to the above-mentioned configuration, it is possible to image-process (e.g., scan or print) the second sheet at the time when the first sheet passes through the third passageway.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a first state of an automatic sheet feeder according to a first

embodiment of the invention.

FIG. 2 shows a second state of the automatic sheet feeder according to the first embodiment of the invention.

FIG. 3 shows a third state of the automatic sheet feeder according to the first embodiment of the invention.

FIG. 4 shows a fourth state of the automatic sheet feeder according to the first embodiment of the invention.

FIG. 5 shows an automatic sheet feeder according to a second embodiment of the invention.

FIG. 6 shows a first state of an automatic sheet feeder according to a third embodiment of the invention.

FIG. 7 shows a second state of the automatic sheet feeder according to the third embodiment of the invention.

FIG. 8 shows a third state of the automatic sheet feeder according to the third embodiment of the invention.

FIG. 9 shows a fourth state of the automatic sheet feeder according to the third embodiment of the invention.

FIG. 10 shows a first state of an automatic sheet feeder according to a fourth embodiment of the invention.

FIG. 11 shows a second state of the automatic sheet feeder according to the fourth embodiment of the invention.

FIG. 12 shows a third state of the automatic sheet feeder according to the fourth embodiment of the invention.

FIG. 13 shows a fourth state of the automatic sheet feeder according to the fourth embodiment of the invention.

FIG. 14 shows a first state of an automatic sheet feeder according to a fifth embodiment of the invention.

FIG. 15 shows a second state of the automatic sheet feeder according to the fifth embodiment of the invention.

FIG. 16 shows a first state of an automatic sheet feeder according to a sixth embodiment of the invention.

FIG. 17 shows a second state of the automatic sheet feeder according to the sixth embodiment of the invention.

FIG. 18 shows an automatic sheet feeder according to a seventh embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. 1 to 4 show several states of an automatic sheet feeder according to a first embodiment of the invention, respectively. As shown in FIG. 1, the automatic sheet feeder is applied to a sheet-fed scanner. However, in other embodiments, the automatic sheet feeder also may be combined with a flatbed scanner, or applied to a printer. The automatic sheet feeder includes a sheet input tray 10, a first passageway 12, a second passageway 14, a third passageway 16, a sheet-feeding mechanism 30, and a sheet output tray 50.

The sheet input tray 10 is used to store a plurality of sheets including a first sheet P1 and a second sheet P2. Each of the sheets has a front side and a back side. For example, the first sheet P1 has a front side P1A and a back side P1B.

The sheets may be successively fed through the first passageway 12, the second passageway 14 and the third passageway 16 one by one. The first passageway 12 communicates with the sheet input tray 10. A first end 14A of the second passageway 14 selectively communicates with the first passageway 12, and a second end 14B of the second passageway 14 communicates with the first passageway 12. The third passageway 16 selectively communicates with the first passageway 12.

The sheet-feeding mechanism 30 feeds the first sheet P1 successively from the sheet input tray 10 to the first passageway 12, the second passageway 14, the first passageway 12, and the third passageway 16.

The sheet output tray 50, in which the sheets are stored, communicates with the third passageway 16. In order to increase the sheet-feeding speed, the automatic sheet feeder of the invention is configured such that the front side P1A of the first sheet P1 is toward opposite directions when it passes through the first passageway 12 at the first and second times. In addition, when the first sheet P1 is fed into the third passageway 16, the second sheet P2 is fed into the first passageway 12.

In the embodiment, the first passageway 12 includes a main passageway 12A, a first sub-passageway 12B, a second sub-passageway 12C, and a main/sub-

passageway guiding rod 12D. The main passageway 12A communicates with the sheet input tray 10, the first sub-passageway 12B communicates with the main passageway 12A and the second passageway 14, and the second sub-passageway 12C communicates with the main passageway 12A and the third passageway 16. The main/sub-passageway guiding rod 12D switchably guides the first sheet P1 from the main passageway 12A to pass through the first sub-passageway 12B or the second sub-passageway 12C.

The automatic sheet feeder of the embodiment further includes a first temporary storage region 22, a first guiding rod 26, a second temporary storage region 24, and a second guiding rod 28. The first temporary storage region 22, in which the first sheet P1 from the first sub-passageway 12B is temporarily stored, selectively communicates with the first sub-passageway 12B and the second passageway 14. The first guiding rod 26 switchably guides the first sheet P1 from the first sub-passageway 12B to the first temporary storage region 22, and guides the first sheet P1 from the first temporary storage region 22 to the second passageway 14. The second temporary storage region 24, in which the first sheet P1 from the second sub-passageway 12C is temporarily stored, selectively communicates with the second sub-passageway 12C and the third passageway 16. The second guiding rod 28 switchably guides the first sheet P1 from the second sub-passageway 12C to the second temporary storage region 24, and guides the first sheet P1 from the second temporary storage region 24 to the third passageway 16.

In addition, an image processing region 20 is formed on the main

passageway 12A. In the so-called image processing region 20, an image processing module opposite to the image processing region 20 may perform image processing on the sheet passing through the region 20. For example, the first sheet P1 may be scanned by a scanning module 60 including an image sensor 61 and a reflecting mirror 62, or may be printed by a printing module (not shown).

In the embodiment, the sheet-feeding mechanism 30 includes a sheet-input roller 31, first to third roller sets 32 to 34, and a sheet-output roller set 39. The sheet-input roller 31 feeds the first sheet P1 from the sheet input tray 10 to the main passageway 12A. The first roller set 32 is located on the main passageway 12A to assist in feeding the first sheet P1 from the sheet input tray 10 to the first sub-passageway 12B. The front side P1A of the first sheet P1 faces downward in the image processing region 20, and is scanned by the scanning module 60.

At this time, the main/sub-passageway guiding rod 12D swings downward to connect the first sub-passageway 12B with the main passageway 12A and disconnect the second sub-passageway 12C from the main passageway 12A. In addition, the first guiding rod 26 swings upward to enable the second roller set 33 to feed the first sheet P1 from the first sub-passageway 12B to the first temporary storage region 22.

Referring next to FIG. 2, after the first sheet P1 has left the first sub-passageway 12B, the second roller set 33 is reversed and the first guiding rod 26 swings downward so that the second roller set 33 may feed the first sheet P1 from the first temporary storage region 22 to the second passageway 14. Then, the first sheet P1 enters the main passageway 12A from the second end 14B of the second

passageway 14, the back side P1B of the first sheet P1 in the image processing region 20 faces downward (the front side P1A faces upward) and is scanned by the scanning module 60.

Referring next to FIG. 3, the main/sub-passageway guiding rod 12D swings upward so that the first roller set 32 may assist in feeding the first sheet P1 from second passageway 14 to the second sub-passageway 12C.

Then, the second guiding rod 28 swings downward to guide the first sheet P1 to the third roller set 34, which feeds the first sheet P1 from the second sub-passageway 12C to the second temporary storage region 24.

Referring next to FIG. 4, after the first sheet P1 has left the second sub-passageway 12C, the third roller set 34 is reversed and the second guiding rod 28 swings upward so that the third roller set 34 may feed the first sheet P1 from the second temporary storage region 24 to the third passageway 16. Then, when the sheet-output roller set 39 feeds the first sheet P1 in the third passageway 16 to the sheet output tray 50, the sheet-input roller 31 also feeds the second sheet P2 to the first passageway 12 for scan, and the overall scanning time may be saved accordingly.

If the front sides of the sheets in the sheet input tray 10 face downward, the front sides of the sheets in the sheet output tray 50 also face downward and the order of the sheets is kept unchanged after the above-mentioned sheet-feeding processes are performed

On the other hand, when the simplex image processing such as simplex

scanning is to be performed, the sheet may be fed to the second temporary storage region 24 and separated from the third roller set 34 and then falls down to the sheet output tray 50.

FIG. 5 shows an automatic sheet feeder according to a second embodiment of the invention. The second embodiment is similar to the first embodiment except that the automatic sheet feeder of the second embodiment is combined with a flatbed scanner 70 but the automatic sheet feeder of the first embodiment is applied to the sheet-fed scanner.

FIGS. 6 to 9 show several states of an automatic sheet feeder according to a third embodiment of the invention, respectively. As shown in FIGS. 6 to 9, the automatic sheet feeder of the third embodiment of the invention is similar to that of the first embodiment. The automatic sheet feeder of the first embodiment, which is a straight forward type automatic sheet feeder, is applied to the sheet-fed scanner and the sheet is fed in an L-shaped path. However, the automatic sheet feeder of the third embodiment, which is a U-shaped type automatic sheet feeder, is used in combination with a flatbed scanner (similar to FIG. 5 but not shown) having a movable scanning module 60, the sheet is fed in a U-shaped path, and an auxiliary roller set 38 and a first roller set 32 that may be omitted is newly added. The second roller set 33 and the auxiliary roller set 38 may be designed to share one roller and the image processing region 20 is located between two first roller sets 32. Since the operations of this embodiment is the same as those of the first embodiment, detailed description thereof will be omitted but only illustrated in the drawings.

On the other hand, when the simplex image processing such as simplex scanning is to be performed, the height of the temporary tray 21 may be lowered from the Q1 point down to the Q2 point. Then, the sheet is fed to the first temporary storage region 22 and separated from the second roller set 33 and then falls down to the sheet output tray 50. It is to be noted that when the height of the temporary tray 21 is lowered from the Q1 point to the Q2 point, the duplex scanning processes will not be influenced because the sheet is not released by the second roller set 33.

FIGS. 10 to 13 show several states of an automatic sheet feeder according to a fourth embodiment of the invention, respectively. As shown in FIG. 10, the automatic sheet feeder is similar to that of FIG. 5 and is used in combination with a flatbed scanner. For the sake of simplicity, only the scanning module 60 is depicted. However, in other embodiments, the automatic sheet feeder also may be applied to a printer. The automatic sheet feeder includes a sheet input tray 10, a first passageway 12, a second passageway 14, a third passageway 16, a sheet-feeding mechanism 30, and a sheet output tray 50.

The sheet input tray 10 is used to store a plurality of sheets including a first sheet P1 and a second sheet P2. Each of the sheets has a front side and a back side. For example, the first sheet P1 has a front side P1A and a back side P1B.

The sheets may be successively fed through the first passageway 12, second passageway 14 and third passageway 16. The first passageway 12 communicates with the sheet input tray 10. A first end 14A of the second passageway 14 selectively communicates with the first passageway 12, a second end 14B of the

second passageway 14 communicates with the first passageway 12. The third passageway 16 selectively communicates with the first passageway 12.

The sheet-feeding mechanism 30 feeds the first sheet P1 successively from the sheet input tray 10 to the first passageway 12, the second passageway 14, the first passageway 12, and the third passageway 16.

The sheet output tray 50, in which the sheets may be stored after the scanning processes, communicates with the third passageway 16. In order to increase the sheet-feeding speed, the automatic sheet feeder of the invention is designed such that the front side P1A of the first sheet P1 is toward opposite directions when it passes through the first passageway 12 at the first and second times. When the first sheet P1 is fed to the third passageway 16, the second sheet P2 is fed to the first passageway 12.

The automatic sheet feeder in the embodiment further includes a first temporary storage region 22, a first guiding rod 26, and a second guiding rod 28. The first temporary storage region 22, in which the first sheet P1 from the first passageway 12 is temporarily stored, selectively communicates with the first passageway 12 and the second passageway 14. The first guiding rod 26 switchably guides the first sheet P1 from the first passageway 12 to the first temporary storage region 22, and guides the first sheet P1 from the first temporary storage region 22 to the second passageway 14. The second guiding rod 28 switchably guides the first sheet P1 from the first passageway 12 to the first temporary storage region 22 or third passageway 16. In addition, an image processing region 20 as described above is formed on the first passageway 12.

In the embodiment, the sheet-feeding mechanism 30 includes a sheet-input roller 31, a first roller set 32, a second roller set 33, a third roller set 34, a fourth roller set 35, a fifth roller set 36 and a sheet-output roller set 39.

First, the sheet-input roller 31 feeds the first sheet P1 from the sheet input tray 10 to the first passageway 12. The front side P1A of the first sheet P1 in the image processing region 20 faces downward and is scanned by the scanning module 60. The first roller set 32 and the second roller set 33 are located on the first passageway 12 to assist in feeding the first sheet P1 from the sheet input tray 10 to the first temporary storage region 22. At this time, the first guiding rod 26 swings upward and the second guiding rod 28 swings downward to guide the first sheet P1 to the third roller set 34. Next, the third roller set 34 feeds the first sheet P1 from the first passageway 12 to the first temporary storage region 22.

Referring next to FIG. 11, after the first sheet P1 has left the first passageway 12, the third roller set 34 is reversed, and the first guiding rod 26 swings downward so that the third roller set 34 may feed the first sheet P1 from the first temporary storage region 22 to the second passageway 14. Then, the first sheet P1 enters the first passageway 12 from the second end 14B the second passageway 14, and the back side P1B of the first sheet P1 in the image processing region 20 faces downward (the front side P1A faces upward) and is scanned by the scanning module 60.

Next, referring to FIG. 12, the second guiding rod 28 swings upward to guide the first sheet P1 to the third passageway 16. It is to be noted that the third roller set 34 and the fourth roller set 35 share one roller.

Then, as shown in FIG. 13, when the first sheet P1 is still fed in the third passageway 16, the second sheet P2 has been fed to the first passageway 12 for scan, and the overall scanning time may be saved accordingly.

If the front sides of the sheets in the sheet input tray 10 face downward, the front sides of the sheets in the sheet output tray 50 also face downward and the order of the sheets is kept unchanged after the above-mentioned sheet-feeding processes are performed.

On the other hand, when the simplex image processing such as simplex scanning is to be performed, the height of the temporary tray 21 may be lowered from the Q1 point down to the Q2 point. Then, the sheet is fed to the first temporary storage region 22 and separated from the third roller set 34 and then falls down to the sheet output tray 50. It is to be noted that when the height of the temporary tray 21 is lowered from the Q1 point to the Q2 point, the duplex scanning processes will not be influenced because the sheet is not released by the third roller set 34. Consequently, the sheet-feeding mechanisms 30 in FIGS. 1 to 13 may selectively perform a duplex sheet-feeding mode and a simplex sheet-feeding mode. In the duplex sheet-feeding mode, the sheet-feeding mechanism 30 feeds the first sheet P1 or the second sheet P2 from the sheet input tray 10 successively through the first passageway 12, the second passageway 14, the first passageway 12 and third passageway 16, and finally to the sheet output tray 50. In the simplex sheet-feeding mode, the sheet-feeding mechanism 30 feeds the first sheet P1 or the second sheet P2 from the sheet input tray 10 through the first passageway 12 and finally to the sheet output tray 50. After the simplex sheet-

feeding mode or duplex sheet-feeding mode, the relatively order between the first sheet and the second sheet is kept unchanged.

Consequently, the invention sufficiently utilizes the time when the first sheet is fed through the third passageway to feed and scan the second sheet, so the overall scanning time may be effectively shortened and the duplex scanning operation may be accelerated without influencing the scanning effects. Alternatively, when the automatic sheet feeder is applied to a printer, the overall printing time also may be effectively shortened.

According to the above-mentioned embodiments, the automatic sheet feeder of the invention may satisfy the facilitated functions of duplex and simplex image processing, effectively accelerate the duplex image processing, and greatly shorten the image processing time.

FIGS. 14 and 15 show the first and second states of the automatic sheet feeder according to a fifth embodiment of the invention. Referring to FIGS. 14 and 15, the fifth embodiment of the invention provides an automatic sheet feeder including a sheet input tray 10, a sheet output tray 50, a first passageway 12, a second passageway 14, and a sheet-feeding mechanism 30.

The sheet input tray 10 is used to store a plurality of sheets including a first sheet P1 and a second sheet P2. Each of the sheets has a front side (e.g., P1A) and a back side (e.g., P1B). The sheet output tray 50 may store the sheets after being fed. The sheets may be successively fed through the first passageway 12 and the second passageway 14. The first passageway 12 communicates with the sheet

input tray 10, a first end 14A of the second passageway 14 selectively communicates with the first passageway 12, a second end 14B of the second passageway 14 communicates with the first passageway 12. The sheet-feeding mechanism 30 feeds the first sheet P1 from the sheet input tray 10 successively through the first passageway 12, the second passageway 14 and the first passageway 12, and finally to the sheet output tray 50.

The first passageway 12 includes a main passageway 12A communicating with the sheet input tray 10, a first sub-passageway 12B communicating with the main passageway 12A and the second passageway 14, a second sub-passageway 12C communicating with the main passageway 12A and the sheet output tray 50, and a main/sub-passageway guiding rod 12D for switchably guiding the first sheet P1 from the main passageway 12A to the first sub-passageway 12B or the second sub-passageway 12C.

A temporary storage region 22 selectively communicates with the first sub-passageway 12B and the second passageway 14 to temporarily store the first sheet P1 coming from the first sub-passageway 12B. A first guiding rod 26 switchably guides the first sheet P1 from the first sub-passageway 12B to the temporary storage region 22, and the first sheet P1 from the temporary storage region 22 to the second passageway 14.

The main passageway 12A may be formed with an image processing region 20. A scanning module 60 or a printing module (not shown) may be provided in correspondence with the image processing region 20 to process (e.g., scan or print) the sheet passing through the image processing region 20.

The sheet-feeding mechanism 30 includes a sheet-input roller 31, a first roller set 32, a second roller set 33 and a sheet-output roller set 39. The sheet-input roller 31 feeds the first sheet P1 from the sheet input tray 10 to the main passageway 12A. The first roller set 32 is located on the main passageway 12A to assist in feeding the first sheet P1 from the sheet input tray 10 to the first sub-passageway 12B, and the first sheet P1 from the second passageway 14 to the second sub-passageway 12C. The second roller set 33 feeds the first sheet P1 from the first sub-passageway 12B to the temporary storage region 22 and the first sheet P1 from the temporary storage region 22 to the second passageway 14. The sheet-output roller set 39 feeds the first sheet P1 from the second sub-passageway 12C to the sheet output tray 50.

In this embodiment, when the duplex scanning is performed, the sheet only has to be turned over twice but not thrice. Thus, time may be saved.

FIGS. 16 and 17 show two states of an automatic sheet feeder according to a sixth embodiment of the invention. Referring to FIGS. 16 and 17, the sixth embodiment of the invention provides an automatic sheet feeder including a sheet input tray 10, a sheet output tray 50, a first passageway 12, a second passageway 14 and a sheet-feeding mechanism 30.

The sheet input tray 10 is used to store a plurality of sheets including a first sheet P1 and a second sheet P2. Each of the sheets has a front side (e.g., P1A) and a back side (e.g., P1B). The sheet output tray 50 may store the sheets after being fed. The sheets may be successively fed through the first passageway 12 and the second passageway 14. The first passageway 12 communicates with the sheet

input tray 10, a first end 14A of the second passageway 14 selectively communicates with the first passageway 12, a second end 14B of the second passageway 14 communicates with the first passageway 12. The sheet-feeding mechanism 30 feeds the first sheet P1 from the sheet input tray 10 successively through the first passageway 12, the second passageway 14 and the first passageway 12, and finally to the sheet output tray 50.

A temporary storage region 22 selectively communicates with the first passageway 12 and the second passageway 14 to temporarily store the first sheet P1 from the first passageway 12. A first guiding rod 26 switchably guides the first sheet P1 from the first passageway 12 to the temporary storage region 22, and the first sheet P1 from the temporary storage region 22 to the second passageway 14. A second guiding rod 28 switchably guides the first sheet P1 from the first passageway 12 to the temporary storage region 22 or the sheet output tray 50.

The first passageway 12 may be formed with an image processing region 20. A scanning module 60 or a printing module (not shown) may be provided in correspondence with the image processing region 20 to process (e.g., scan or print) the sheet passing through the image processing region 20.

The sheet-feeding mechanism 30 includes a sheet-input roller 31, a first roller set 32, a second roller set 33, and a sheet-output roller set 39. The sheet-input roller 31 feeds the first sheet P1 from the sheet input tray 10 to the first passageway 12. The first roller set 32 and the second roller set 33 are located on the first passageway 12 to assist in feeding the first sheet P1 from the sheet input tray 10 to the temporary storage region 22, and the first sheet P1 from the second

passageway 14 to the sheet output tray 50. The sheet-output roller set 39 feeds the first sheet P1 from the first passageway 12 to the sheet output tray 50. In this embodiment, the second roller set 33 and the sheet-output roller set 39 share the same roller.

FIG. 18 shows an automatic sheet feeder according to a seventh embodiment of the invention. The embodiment is similar to the sixth embodiment except that the second guiding rod 28 and the second roller set 33 of FIG. 16 are omitted and a sheet-output roller set 39 is used instead of the second roller set 33. Consequently, the sheet-feeding mechanism 30 includes a sheet-input roller 31, a first roller set 32 and a sheet-output roller set 39. The sheet-input roller 31 feeds the first sheet P1 from the sheet input tray 10 to the first passageway 12. The first roller set 32 is located on the first passageway 12 to assist in feeding the first sheet P1 from the sheet input tray 10 to the temporary storage region 22, and the first sheet P1 from the second passageway 14 to the temporary storage region 22. The sheet-output roller set 39 feeds the first sheet P1 from the first passageway 12 to the temporary storage region 22, and then feeds the first sheet P1, which is temporarily stored in the temporary storage region 22, to the second passageway 14. The sheet-output roller set 39 further feeds the first sheet P1 from the second passageway 14 and the first passageway 12 to the temporary storage region 22 and then release the first sheet P1 to let it fall down to the sheet output tray 50.

Compared to the sixth embodiment, the automatic sheet feeder of the seventh embodiment has a simpler structure.

According to the above-mentioned embodiments, the automatic sheet feeder

of the invention may effectively accelerate the duplex image processing and greatly shorten the image processing time.

While the invention has been described by way of examples and in terms of preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments. To the contrary, it is intended to cover various modifications. Therefore, the scope of the appended claims should be accorded the broadest interpretation so as to encompass all such modifications.